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JÖRG W. MÜLLER (*)

CREPUSIUS AND POSSIBLE SHIPWRECKS

Abstract

The die sequences of the Crepusius denarii are nowadays sufficiently well known that possible abnormal losses in the empirical distribution can be recognized. While for no group all the letters of the obverse dies have been found, this is not surprising, but absences would be expected to occur randomly. However, for two of the 24 groups we find quite an abnormal pattern: the last 14 of the 21 letters are missing. This is shown to be incompatible with losses by chance. We suggest that coin deliveries from the mint have been lost (e.g. in a shipwreck) before the pieces could enter into normal circulation.

1. Introduction

Regarding coin transports, it is easy to ask questions for which we cannot expect to find useful answers. In particular, coin finds and hoards are usually of limited interest — unless we look at them in a very special way. If we can use an issue for which a complete die analysis exists and where the system of numbering is understood, then there may be some hope, for in this case the problem might be « inverted » by looking not only at what has been found, but also for possible « gaps » in the empirical sequence of dies.

These conditions are so severe that, for the time being, there is probably only a single case in numismatics where the approach can be checked, and this concerns the denarii of Crepusius, from the Roman Republic (1).

2. A quick look at the coins

In fact, Crepusius is not the only case where we have a simple enumeration scheme for both dies, but probably the one most thoroughly

(*) Jörg W. MÜLLER, rue Armand Silvestre 195, F-92400 Courbevoie.

(1) C.A. HERSH, *Sequence Marks on Denarii of Publius Crepusius*, in *NC*, s. 6, 12, 1952, p. 52-66; T.V. BUTTREY, *The Denarii of P. Crepusius and Roman Republican Mint Organization*, in *ANSMN*, 21, 1976, p. 67-108.

RBN, 152, 2006, p. 15-21.

studied. On the obverses we find symbols for 25 groups (the last one is very incomplete) which are subdivided by the 21 letters of the Latin alphabet, i.e.

A,	B,	C,	D,	E,	F,	G,
H,	I,	K,	L,	M,	N,	O,
P,	Q,	R,	S,	T,	V,	X.

The reverses are numbered (up to 519 at least). In this way, all dies are readily characterized.

Even in the most complete recent listing by Carter (2) there are numerous gaps, both in the numbers and in the letters (for a given group). This is not surprising for a limited sample. Only, they should display a certain « random » behaviour. If gaps are suspiciously long, we must look for another explanation.

Such long gaps have already been noted earlier by Carter (3), but he thought that some groups, for reasons unknown to us, had not been fully coined. Considering the elaborate numbering system, we find such an explanation unlikely. Rather, we shall assume that (in principle) all series were fully struck as planned, but that a few of them may not have been distributed normally. Many possibilities for an anomaly can be imagined; perhaps the simplest is to assume that one transport or two have been lost, for example in a shipwreck.

3. A closer look

Suspicious gaps in the available record can occur either in the numbers (reverses) or in the letters (obverses); this depends on the organization of the mint. We went through all of Carter's listing (4) and tried various arrangements. If the data are listed according to groups and letters, we find two abnormal cases, namely:

(2) G.F. Carter, Document without title, dated Feb. 26, 1992, distributed privately. This is a detailed listing of more than 2 200 Crepusius denarii, arranged according to reverse die numbers.

(3) G.F. Carter, *Die-link Statistics for Crepusius Denarii and Calculations of the Total Number of Dies*, in *PACT*, 5, 1981, p. 193-213.

(4) See note 2.

a) Group 9 (Thyrsus)

letter	nb. n_i of coins	letter	nb. n_i of coins
A	2	H	0
B	0	I	0
C	14		
D	16	...	...
E	0		
F	13	V	0
G	3	X	0
		total	48

b) Group 20 (Altar)

letter	nb. n_i of coins	letter	nb. n_i of coins
A	3	H	0
B	1	I	0
C	1		
D	11	...	...
E	1		
F	4	V	0
G	12	X	0
			total 33

In these two cases there are clearly large gaps in the sequence of letters: in « Thyrsus » of 15 and in « Altar » of 14 consecutive letters. The question is whether this can occur randomly or not. We note that the dies with letter R for Thyrsus and O for Altar, recorded in Buttrey [5], had been misread and are discarded here.

4. Analysis of the data

It cannot be expected that the empirical distribution of the number of coins (n_i) found per letter will just follow one of the statistical standard distributions (e.g. Poisson). The reason is that these have *been* derived for simpler, more idealized situations than those we meet here. Thus, it can

(5) T.V. Buttrey, *op. cit.* (n. 1), p. 67-108.

no longer be assumed that the original number of coins struck per letter was always the same, nor that the « survival » probabilities were identical. This is reflected in the larger variability of the numbers n_i, the coins found per letter.

In order to be in a position to distinguish between probable and improbable gaps, we need at least an approximate model which can give « order of magnitude » estimates for their probability. This is the purpose of the following considerations.

For a given group, let us form the « statistic » s_i which is defined by:

$$s_i = \begin{cases} 0, & \text{if } n_i = 0 \\ 1, & \text{if } n_i \geq 1, \end{cases}$$

where n_i is the number of coins struck with letter i.
For the probability p' to find coins of a specific letter in the group under consideration we can form:

$$p' = \sum_i s_i/21,$$

which is the ratio of the letters which have been actually found on coins to their total number. The sum extends over all the (regular) letters of the group, thus normally 21.

For groups 9 and 20, this regularity probably applies only to the first 7 letters, so that for them we put:

$$p' = \sum_i s_i/7.$$

It follows that the probability p for finding that a letter is *lacking* in the group is $p = 1-p'$.

Likewise, by applying the binomial theorem (which assumes that subsequent outcomes are independent), we find that the probability P_k for k *letters lacking in series* is given by:

$$P_k = (1 - p')^k = p^k, \qquad \text{for } 1 \leq k \leq 21 .$$

This simple estimate will be used in what follows. It allows us to check roughly if a gap of a certain length, observed in the empirical record, can be (reasonably) considered as due to chance or not. If the probability thus obtained is ridiculously small, we have to look for another explanation.

5. Some empirical results

Let us first consider the two suspicious groups discussed in section 3. Application of the formulae derived above gives:

— for group 9: $p' = 4/7 \cong 0.57$.

For the 3 (individual) gaps in the first 7 letters this leads to $P_1 = 3/7 \cong 0.43$, which poses no problem. However, the ensuing gap of $k = 14$ letters would correspond to about $P_{14} = 7 \times 10^{-6}$, which is too small to be reasonable;

— for group 20, the situation is similar: as all the first seven letters have been found, we have $p' = 1$, and therefore $P_{14} = 0$.

Therefore, the distributions found in both cases are highly abnormal and cannot be explained by statistics. A serious perturbation « from outside » must have affected these two groups.

What about the other 22 groups of the denarii of Crepusius? How do they behave if we apply to them the same checks? It will be decisive for our confidence in the statistical conclusions that they all behave « better ». The comparisons have been made for all the material assembled by Carter, and no further problems have been found. In order to give a general overall view of them, it will be sufficient to list below some essential data in condensed form, in particular for groups with many gaps.

group	nb. of missing letters	in series (up to k)	prob. P_k for largest gap
18*	9	6	0.01
3*	5	3	0.01
24	6	3	0.02
15, 16, 19	1	1	0.05
6, 14*	5	2	0.06
17*	7	2	0.11
4, 8	3	1	0.14
5*, 21, 23	8	2	0.15

* groups considered as « short » by Carter (6).

The cases given above are the most critical ones for our controls. However, they all correspond to probabilities of at least 1% (often much more). According to statistical habits, they are therefore considered as acceptable, i.e. as accidental losses. This strengthens our claim.

(6) G.F. CARTER, *op. cit.* (n. 3), p. 193-213.

6. Conclusion

An extensive record is available for the denarii of Crepusius (Cr. 361, *ca.* 81 BC) (7), a moneyer otherwise unknown. Assuming that for the obverse dies all (complete) 24 groups included 21 letters, we still find that about 26% of them are unknown. In some cases so few have been found that Carter (8) concluded that 7 groups were « apparently short of having 21 dies ». This assumption was also convenient for improving the agreement with his calculations. Our new analysis shows, however, that it is likely that 21 obverse dies were used for *all* groups, but that in two cases 2/3 of them have not circulated.

Some conclusions can also be drawn about the striking process. First, that the groups were the basic subdivision, although often two of them have been produced « in parallel », judging from the reverse dies. These were used in a rather haphazard way, occasionally up to 5, 6 or even 7 for a given obverse (e.g. for T in group 5). The obverse letters, however, were applied in order.

A group of coins (or also 1/3 or 2/3 of a group, perhaps because 21 cannot be divided by 2) was delivered as soon as it was available. It seems likely, as already suggested by Buttrey (9), that groups were minted at (several) anvils separately.

The chances are clearly very small — but not zero — that one day our hypothesis of a shipwreck can be verified. In this case, not only the group will be checked, but special attention should also be given to the number of coins per letter, as this is likely to answer the old question of the number of coins struck per die, at least for this coinage. This is an essential quantity which appears in various contexts, but is difficult to estimate reliably otherwise.

What about the cargo? The mean weight of a denarius (at that time) is known to be 1/84 of a Roman pound, thus about 3.9 g. For 14 dies lacking (such as in groups 9 and 20) and by assuming an output of some 20,000 coins per die, we can readily estimate that the weight of the lost coins was each time of the order of a ton.

I am particularly glad that the present study — which is no doubt for many a rather unexpected development — could make use of data assembled patiently for quite a different purpose. It would be fine if this example could encourage similar extensive studies of dies.

(7) See note 2.
(8) G.F. Carter, *op. cit.* (n. 3), p. 193-213.
(9) T.V. Buttrey, *op. cit.* (n. 1), p. 67-108.

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(10) See note 2.